

# ANNUAL REPORT FOR 2005



**Bethel Church Mitigation Site**

**Yadkin County**

**Project No. 6.779004T**

**TIP No. R-2120WM**



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## **SUMMARY**

The following report summarizes the monitoring activities that have occurred in the past year at the Bethel Church Mitigation Site. Site construction began in December 2000 and was completed in February 2001. Monitoring activities in 2005 represent the fifth consecutive year of monitoring for the site. The site must demonstrate both hydrologic and vegetation success for a minimum of five years or until the site is deemed successful.

The site is monitored with six groundwater gauges (five in the restoration areas, one in the existing wetland area), one rain gauge and four vegetation plots.

The daily rainfall data depicted on the monitoring gauge graphs was recorded from an onsite rain gauge. An offsite rain gauge, maintained by the NC State Climate Office in Yadkinville, contributed to the daily rainfall data and historical rainfall data used for the 30<sup>th</sup> –70<sup>th</sup> percentile analysis.

The 2005-year represents the fifth consecutive year for hydrology monitoring. Five of the six-groundwater gauges exceeded the optimum success criteria of saturation within 12" of the soil surface for greater than 12.5% of the growing season during an average rainfall year (two gauges met success for 100% of the growing season). Gauge GW-2, which is located in the wetland enhancement area, recorded hydrology for 10.8%, in spite of a data gap at the beginning of the growing season. The groundwater gauges also revealed inundation in some areas. Monitoring gauges 1, 2, 3 and 5 demonstrated groundwater level fluctuations to specific rainfall events, and gauges 4 and 6 experienced periods of ponding due to overbank flooding.

The 2005 vegetation monitoring of the site revealed an average density of 385 trees per acre, which is above the minimum success criteria of 260 trees per acre. The stream channel was visually monitored during the annual vegetation monitoring of the site. A bankfull event had been noted since the last monitoring period. The channel was stable throughout the entire length.

Based on the hydrologic, vegetation, and streambank monitoring, the Bethel Church Mitigation Site met the success criteria for the site during the 2005-growing season. The site has demonstrated both hydrologic and vegetation success for five consecutive years. NCDOT proposes to discontinue all monitoring on the Bethel Church Mitigation Site.

## **1.0 INTRODUCTION**

### **1.1 Project Description**

The Bethel Church Mitigation Site is located on US 421, west of Yadkinville and adjacent to an unnamed tributary to South Deep Creek in Yadkin County (Figure 1). This site mitigates for wetland impacts associated with the improvements to US 421 New Location (R-2120AB).

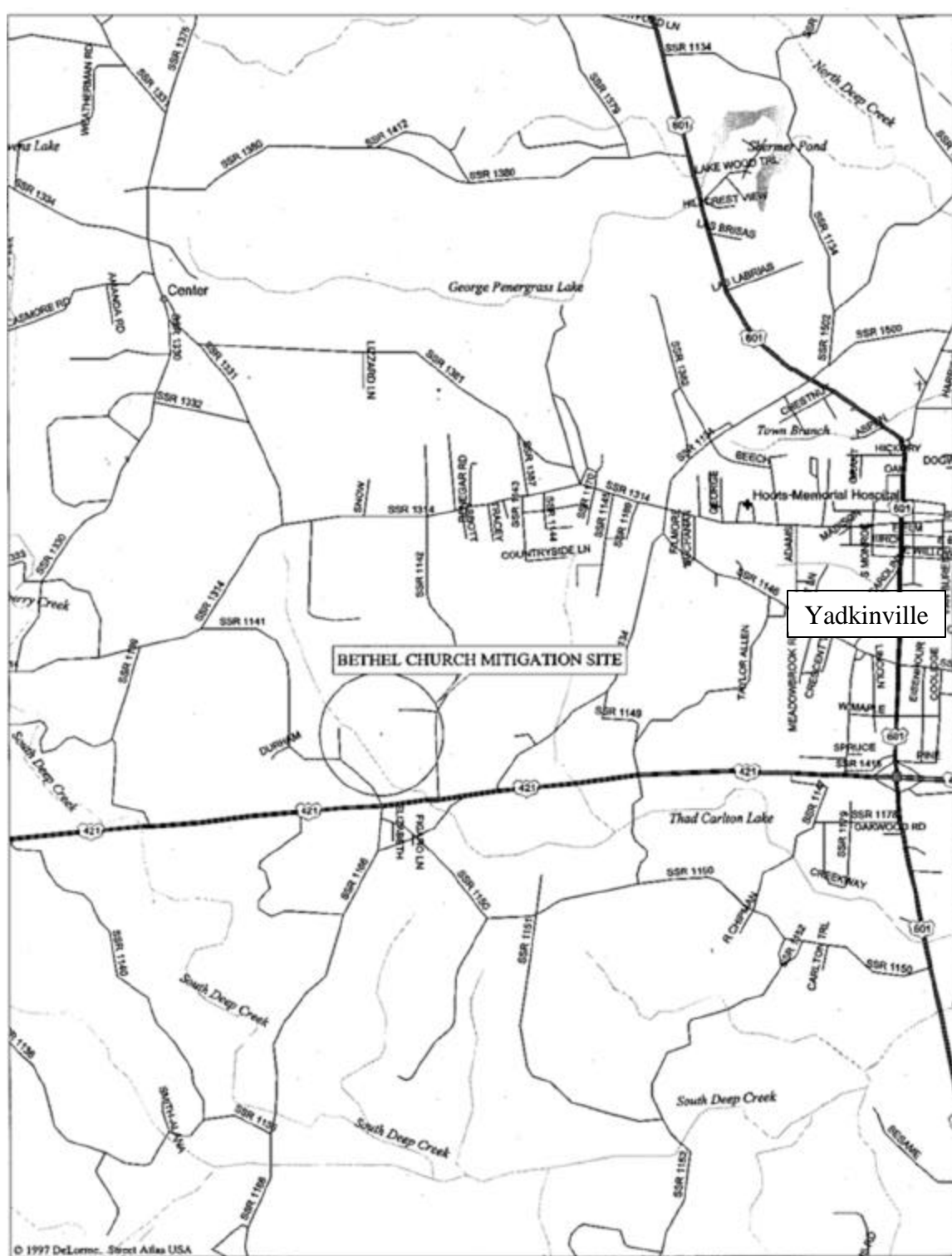
The Bethel Church Mitigation Site is divided into two parcels (North and South), totaling approximately 8.0 acres (ac) in size. The site consists of 3.03 acres of bottomland hardwood wetland restoration, 0.8 acres of wetland enhancement, 850 feet of stream restoration and 4.2 acres of upland buffer. Site construction began in December 2000 and was completed in February 2001. The site was initially planted in March of 2001. In January 2002, supplemental planting was performed in the enhancement area.

In addition to the original mitigation plan, the Department purchased Lots 1-20, which are adjacent parcels of land to the west of Fox Drive and extending (north) up to the Controlled Access along US 421. These parcels are completely wooded, consisting of upland forest and bottomland hardwood floodplain sections adjacent to the stream. By acquiring these parcels, the fill material associated with Fox Drive was completely removed to match the wetland mitigation site contours. The in-stream culvert was also removed during construction.

### **1.2 Purpose**

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five consecutive years. Success criteria for hydrology and vegetation are based on the approved mitigation plan dated August 1998. The following report details the results of hydrologic and vegetative monitoring activities that were performed during the 2005-growing season at the Bethel Church Mitigation Site.

### Figure 1. Site Location Map



### 1.3 Project History

August 1998	Mitigation Plan
February 2001	Site Construction Completed
March 2001	Site Planted
March 2001	Monitoring Gauges Installed
March- October 2001	Hydrologic Monitoring (1 yr.)
July 2001	Vegetation Monitoring (1 yr.)
January 2002	Enhancement Area Supplemental Planting
April- October 2002	Hydrologic Monitoring (2 yr.)
August 2002	Vegetation Monitoring (2 yr.)
April-October 2003	Hydrologic Monitoring (3 yr.)
September 2003	Vegetation Monitoring (3 yr.)
April-October 2004	Hydrologic Monitoring (4 yr.)
June 2004	Vegetation Monitoring (4 yr.)
April-October 2005	Hydrologic Monitoring (5 yr.)
July 2005	Vegetation Monitoring (5 yr.)

## **2.0 HYDROLOGY**

### **2.1 Success Criteria**

Per the mitigation plan dated August 1998, surface and groundwater hydrology on the Bethel Church Mitigation Site shall be monitored for five years following the completion of all implementation activities, or until hydrologic success criteria are met. Hydrologic success for this site is defined as the presence of the water table within 12 inches of the soil surface for 5 -12 % of the growing season during a normal rainfall year.

The growing season in Yadkin County begins April 9 and ends October 28. These dates correspond to a 50% probability that temperatures will drop to 28°F or lower after April 9 and before October 28.<sup>1</sup> The growing season is 202 days; therefore, optimum hydrology requires 12.5% of this season, or at least 25 consecutive days. Local climate must also represent average/normal conditions for the area.

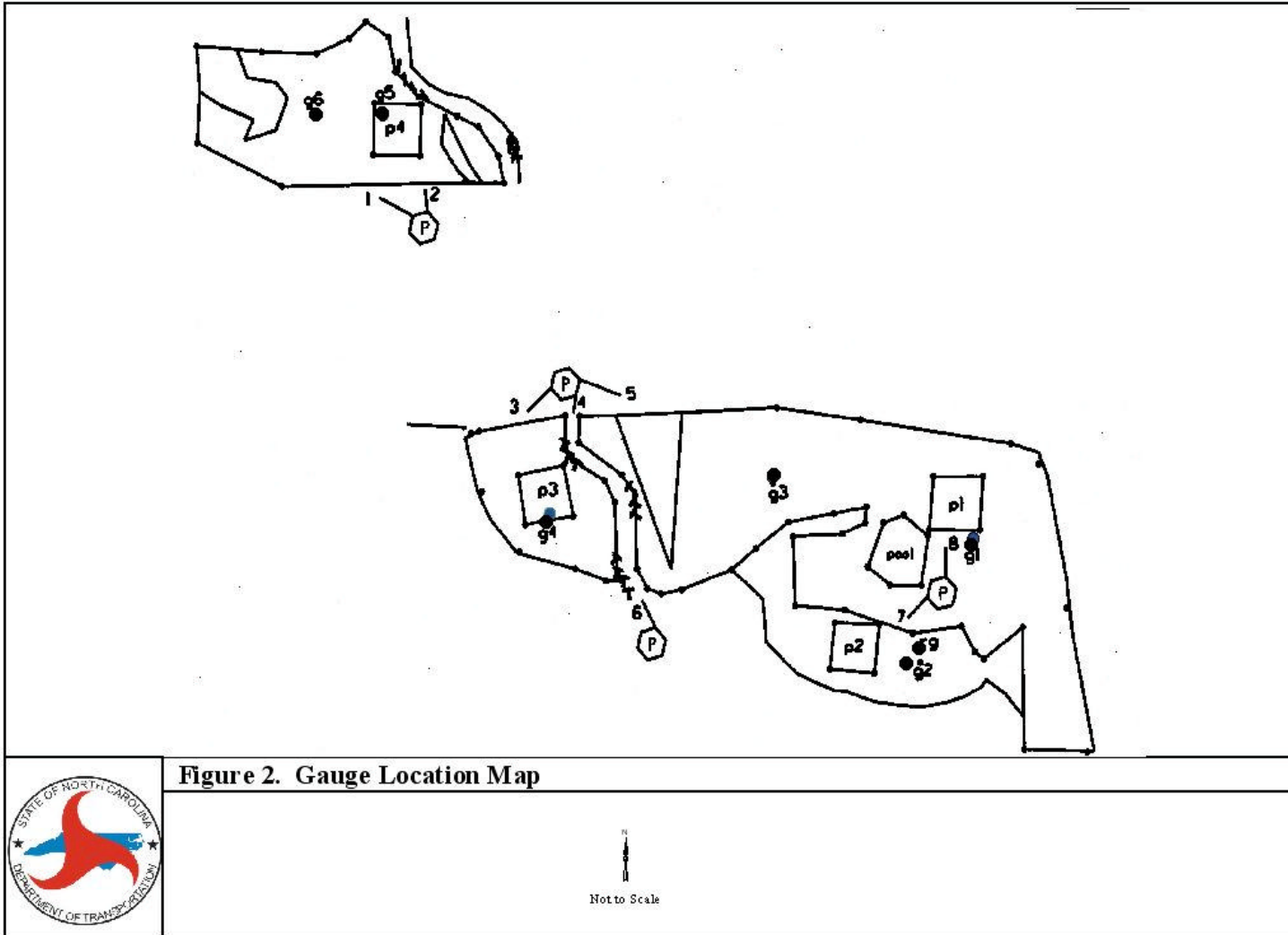
### **2.2 Hydrologic Description**

In March 2001, six groundwater gauges were installed across the site (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth. This represents the fifth growing season that the monitoring gauges have been in place since construction of the site.

The Bethel Church Site was designed to restore the natural flooding regime of the headwater stream. Hydrology for the site is naturally dominated by overbank flooding of the small, unnamed tributary of South Deep Creek. The hydrologic monitoring should show the reaction of the groundwater level to specific rainfall events and the extent of ponding that may be attributed to overbank flooding.

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<sup>1</sup> Soil Conservation Service, Soil Survey of Yadkin County, North Carolina.



## 2.3 Results of Hydrologic Monitoring

### 2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 202-day growing season. The results are presented in Table 1. Figure 3 also provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in green show hydrology between 8% and 12.5% of the growing season. Those gauges highlighted in red indicate wetland hydrology between 5% and 8%.

Appendix A contains a plot of the groundwater depth for each monitoring gauge. The maximum number of consecutive days is noted on each graph. An onsite rain gauge was used to obtain rainfall data from the site. It has been compared with rainfall data obtained from the State Climate Office Local Weather Station in Yadkinville, which is approximately 2 miles from the mitigation site.

**Table 1.** 2005 Hydrologic Monitoring Results

Monitoring Gauge	<5%	5%-8%	8%-12.5%	>12.5%	Actual %	Success Dates
GW-1*				X	54.2	April 9-July 27 July 29-Sept 6 Sept. 17-Oct 28
GW-2			X		10.8	
GW-3*				X	13.8	May 18-June 14
GW-4*				X	100	April 9-Oct 28
GW-5*				X	67.0	June 15-Oct 28
GW-6*				X	100	April 9-Oct 28

The highlighted gauge is located in the existing wetland enhancement area.

\*Gauge met during an average rainfall month.

#### *Specific Gauge Problems:*

- Gauge (GW-2) experienced a malfunction (April 13-June 14). The gauge was reading 6 times a day.
- Gauge (GW- 3) stopped recording data (April 23-May 17). The batteries were replaced.
- Gauge (GW-5) stopped recording data (April 9-May 22). The batteries were replaced.

**Table 2.** Hydrologic Monitoring Results (2001-2005)

<b>Monitoring Gauge</b>	<b>2001 Results</b>	<b>2002 Results</b>	<b>2003 Results</b>	<b>2004 Results</b>	<b>2005 Results</b>
GW-1	11.4	15.8	48.3	100	54.2
GW-2	11.9	8.9	70.4	27.1	10.8
GW-3	11.4	24.1	100	100	13.8
GW-4	65.4	100	100	86.7	100
GW-5	34.7	9.9	100	100	67.0
GW-6	25.7	23.6	100	100	100

The highlighted gauge is located in the existing wetland enhancement area.

Table 2 represents hydrologic data in percentages from previous years (2001-2005).

**Figure 3.** 2005 Hydrologic Monitoring Results

### **2.3.2 Climatic Data**

Figure 4 is a comparison of monthly rainfall for the period of November 2004 through November 2005 to historical precipitation (collected between 1974 and 2005) for Yadkinville, North Carolina. This comparison gives an indication of how 2005 relates to historical data in terms of climate conditions. The NC State Climate Office provided all local rainfall information.

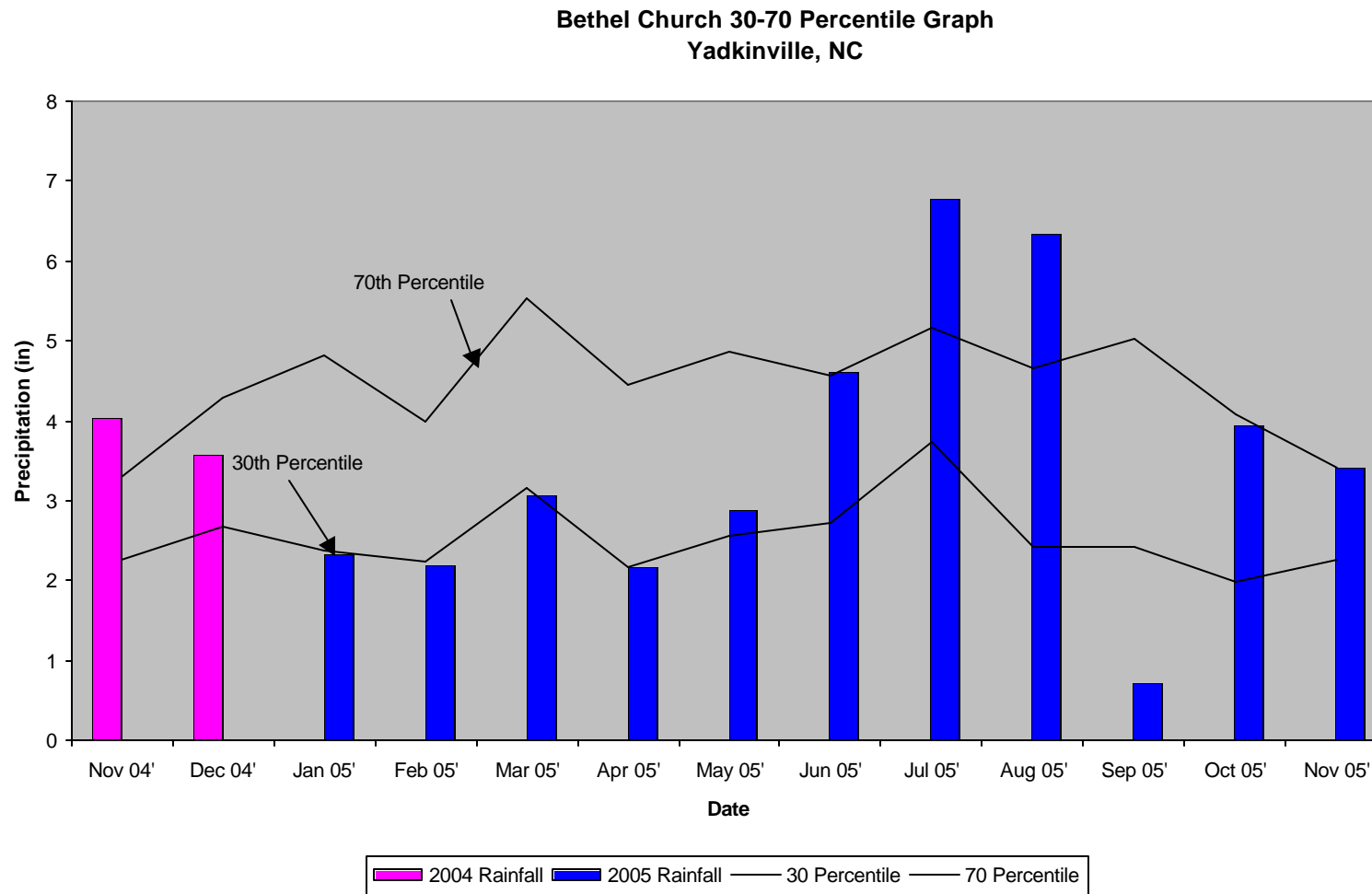
For the 2005-year, November ('04), July, August, and November experienced above average rainfall. The months of January, February, April, and September recorded below average rainfall for the site, while December ('04), March, May, June, and October recorded average rainfall. Overall, 2005 experienced an average rainfall year.

### **2.4 Conclusions**

The 2005-year represents the fifth consecutive year for hydrology monitoring. Five of the six-groundwater gauges exceeded the optimum success criteria of saturation within 12" of the soil surface for greater than 12.5% of the growing season during an average rainfall year. Gauge GW-2, which is located in the wetland enhancement area, recorded hydrology for 10.8% of the growing season. The groundwater gauges also revealed inundation in some areas. Monitoring gauges 1, 2, 3 and 5 demonstrated groundwater level fluctuations to specific rainfall events, and gauges 4 and 6 experienced periods of ponding due to overbank flooding.

This is the fifth consecutive year that the site hydrology has met the success criteria; therefore, NCDOT proposes to discontinue hydrologic monitoring.

**Figure 4: 30-70 Percentile Graph**



### 3.0 VEGETATION: BETHEL CHURCH MITIGATION SITE (YEAR 5 MONITORING)

#### 3.1 Success Criteria

The success criteria are defined as 320 trees per acre of the target species surviving at the end of three years and 260 trees per acre of the target species surviving at the end of five years.

#### 3.2 Description of Species

The following species were planted in the Wetland Restoration Area:

*Carya cordiformis*, Bitternut Hickory

*Fraxinus pennsylvanica*, Green Ash

*Platanus occidentalis*, Sycamore

*Quercus nigra*, Water Oak

*Quercus palustris*, Pin Oak

*Quercus phellos*, Willow Oak

*Quercus rubra*, Northern Red Oak

#### 3.3 Results of Vegetation Monitoring

**Table 3.** 2005 Vegetation Monitoring Results

Plot #	Bitternut Hickory	Green Ash	Sycamore	Water Oak	Pin Oak	Willow Oak	Northern Red Oak	Total (5 year)	Total (at planting)	Density (Trees/Acre)
1		4	10	3		6	1	24	36	453
2		15	4				4	23	40	391
3		15	2		1	8		26	51	347
4		14	1	1		7		23	45	348
AVERAGE DENSITY										385

**Site Notes:** Other species noted: foxtail, ragweed, red maple, *Juncus* sp., *Panicum* sp., *Sagittaria* sp., smartweed, cattail, woolgrass, briars, fennel, pokeweed, silky dogwood, black willow, multi-flora rose, poison ivy, volunteer green ash, lespedeza, goldenrod, river birch, tulip poplar, and tag alder. Plot 2 had heavy growth competition, which made it difficult to find trees. Northern Red Oak was noted growing in higher elevations on the site.

### **3.4 Conclusions**

Red maples in the enhancement area (area around plot 2) were cut and treated with Oust in December 2001. This treatment has been successful in suppressing the red maples. Trees were supplementally planted in the area around plots one and two in January 2002. The 2005 vegetation monitoring of the site revealed an average density of 385 trees per acre, which is above the minimum success criteria of 260 trees per acre.

The stream channel was visually inspected during the annual vegetation monitoring of the site. A bankfull event had been noted since the last monitoring period. The streambanks were highly vegetated with herbaceous species, black willow, silky dogwood, and tag alder. The channel was stable throughout the entire length. Photos 9 through 14 show the conditions of the stream. No maintenance actions are necessary.

NCDOT proposes to discontinue vegetation and channel stability monitoring at the Bethel Church Mitigation Site

## **4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS**

The Bethel Church Mitigation Site has met the success criteria prescribed in the mitigation plan during an average rainfall year. Five of the six-groundwater gauges exceeded the optimum success criteria of saturation within 12" of the soil surface for greater than 12.5% of the growing season during an average rainfall year. Gauge GW-2, which is located in the wetland enhancement area, recorded hydrology for 10.8%, in spite of a data gap (instrument stopped recording) at the beginning of the growing season. The groundwater gauges also revealed inundation in some areas.

The site demonstrated an average density of 385 trees per acre, which is above the minimum success criteria of 260 trees per acre. The stream channel was visually inspected during the annual vegetation monitoring of the site. A bankfull event had been noted since the last monitoring period. The channel was stable throughout the entire length.

Based on the hydrologic, vegetation, and streambank monitoring, the Bethel Church Mitigation Site met the success criteria for the site during the 2005-growing season. The site has demonstrated both hydrologic and vegetation success for five consecutive years. NCDOT proposes to discontinue all monitoring on the Bethel Church Mitigation Site.

## **APPENDIX A**

### **GAUGE DATA GRAPHS**

**APPENDIX B**

**SITE PHOTOGRAPHS**

**PHOTO LOCATIONS & MONITORING PLOTS**

# Bethel Church



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

August 2005



Photo 7



Photo 8



Photo 9 (Stream)



Photo 10 (Stream)



Photo 11 (Stream)

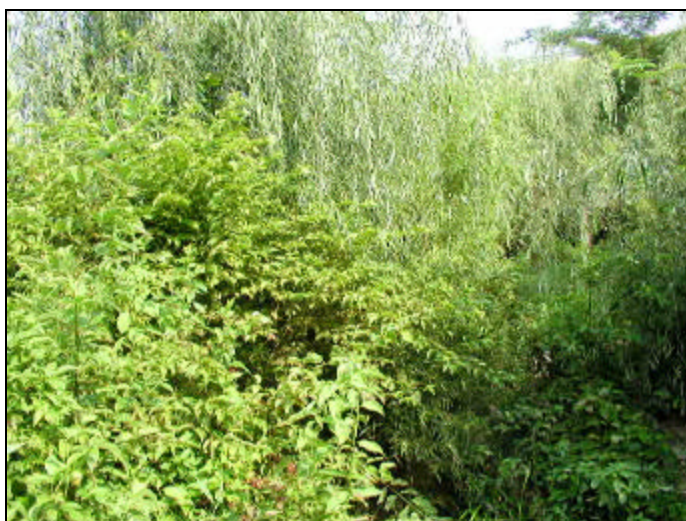


Photo 12 (Stream)

August 2005



Photo 13 (Stream)



Photo 14 (Stream)

August 2005

**Bethel Church Mitigation Site**

This map illustrates the Bethel Church Mitigation Site, showing the locations of photo points (P) and monitoring plots (P1, P2, P3, P4). The site is characterized by a large, irregularly shaped area with a cross-hatched pattern, likely representing a wetland or sensitive habitat. The map includes various geographical features, roads, and infrastructure. Key elements include:

- Photo Locations (P):** Marked with a circle containing the letter 'P'. Locations are numbered 1 through 8.
- Monitoring Plots (P1, P2, P3, P4):** Marked with a square containing the plot number.
- Legend:** A box in the lower right corner defines the symbols: a circle with 'P' for Photo Locations and a square for Monitoring Plots.
- Scale and Orientation:** A north arrow is located in the upper left. A scale bar is provided in the upper right, indicating distances in feet (0 to 100).
- Site Details:** The map shows various roads, including a main road labeled 'R 47 OF 48.5' and a 'ROADWAY (SEE SHEET BW-4 FOR DETAIL)'. It also depicts a 'STEEL PIPE GUY' and 'HYDRAULIC STRUCTURE'.
- Topographic Information:** Elevation points are noted, such as 'ELEV -131+00.540 50.00' and 'ELEV -131+00.000 45.00'.

